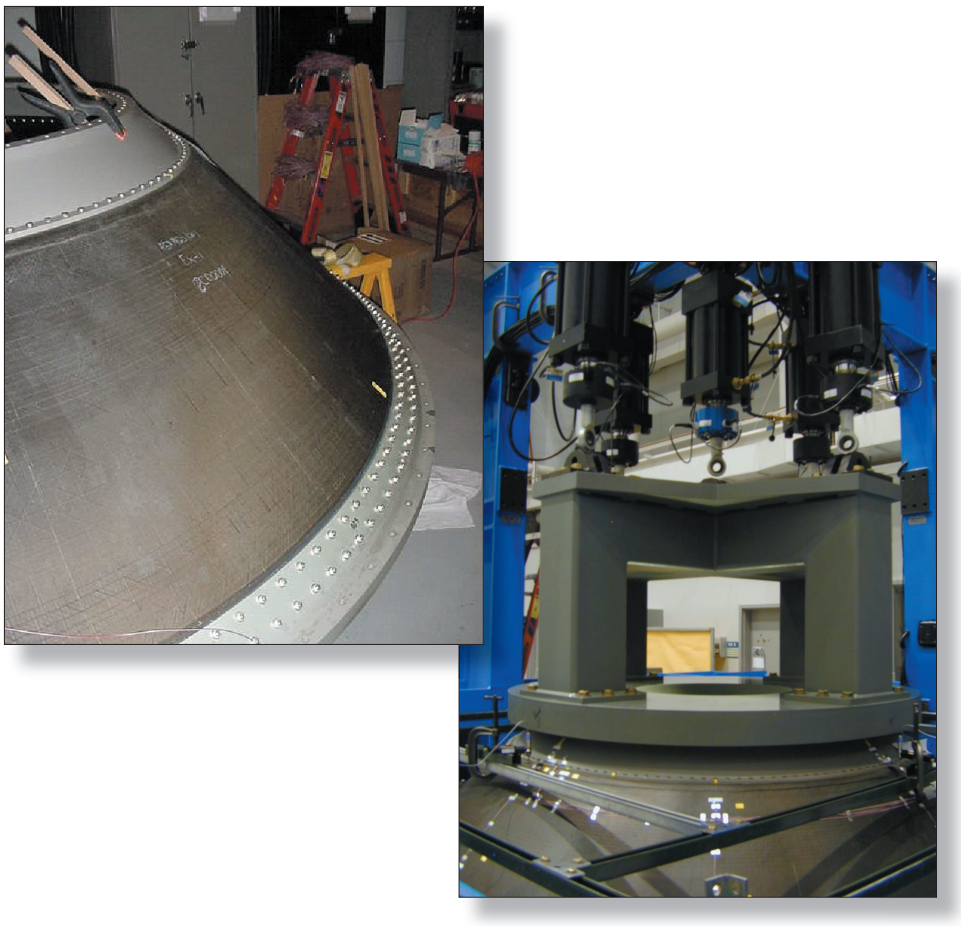
Air Force Research Laboratory|AFRL

Science and Technology for Tomorrow's Air and Space Force

Success Story

EELV ALL-COMPOSITE JOINT PAYLOAD ATTACHMENT FITTING



Boeing Delta IV Payload Accommodations and Alliant Technologies (ATK) developed technology under the Space Vehicles Directorate's sponsorship. The technology was used to demonstrate automated production on an all-composite forward flange for the Boeing-developed 1,780 mm payload attachment fitting for evolved expendable launch vehicles (EELV) and commercial launches. The technology reduces manufacturing costs and mass while maintaining much-better-than-required strength and stiffness.

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Accomplishment

Engineers from the directorate, Boeing, and ATK completed production of a qualification test and cyclic test structure to evaluate the design-critical, all-composite flange detail. The testing successfully qualified the flange to 125% of design load, followed by cyclic testing to 175% of the design load. The joint never gave any indication of distress.

The result of an evolutionary process involving multiple manufacturing and analysis cycles, the design uses Z-pinning (through-thickness fiber reinforcement) technology and composite/foam transitions to control strains and maintain high structure toughness at the high-load attachment points. The forward flange of this test structure was fabricated almost entirely by computer tow-placement methods. Only Z-pins were installed manually. The resulting design will provide a prototype for gradual replacement of most aluminum flanges on launch vehicles with lower cost composite designs.

Background

During the past 20 years, large structural composite adapters and fairings have been gradually introduced to replace heavier aluminum structures. One feature was held over from the earlier all-aluminum designs—the aluminum connections. The aluminum connections provide high ductility and toughness absent until now from many composite structures. The difficulties linked to the use of the aluminum joint are the labor required to install the flanges during composite fabrication (high-touch labor) and the added attention needed to overcome thermal mismatch of these materials during curing.

Space Vehicles
Emerging Technologies

Additional information

To receive more information about this or other activities in the Air Force Research Laboratory, contact TECH CONNECT, AFRL/XPTC, (800) 203-6451 and you will be directed to the appropriate laboratory expert. (04-VS-08)